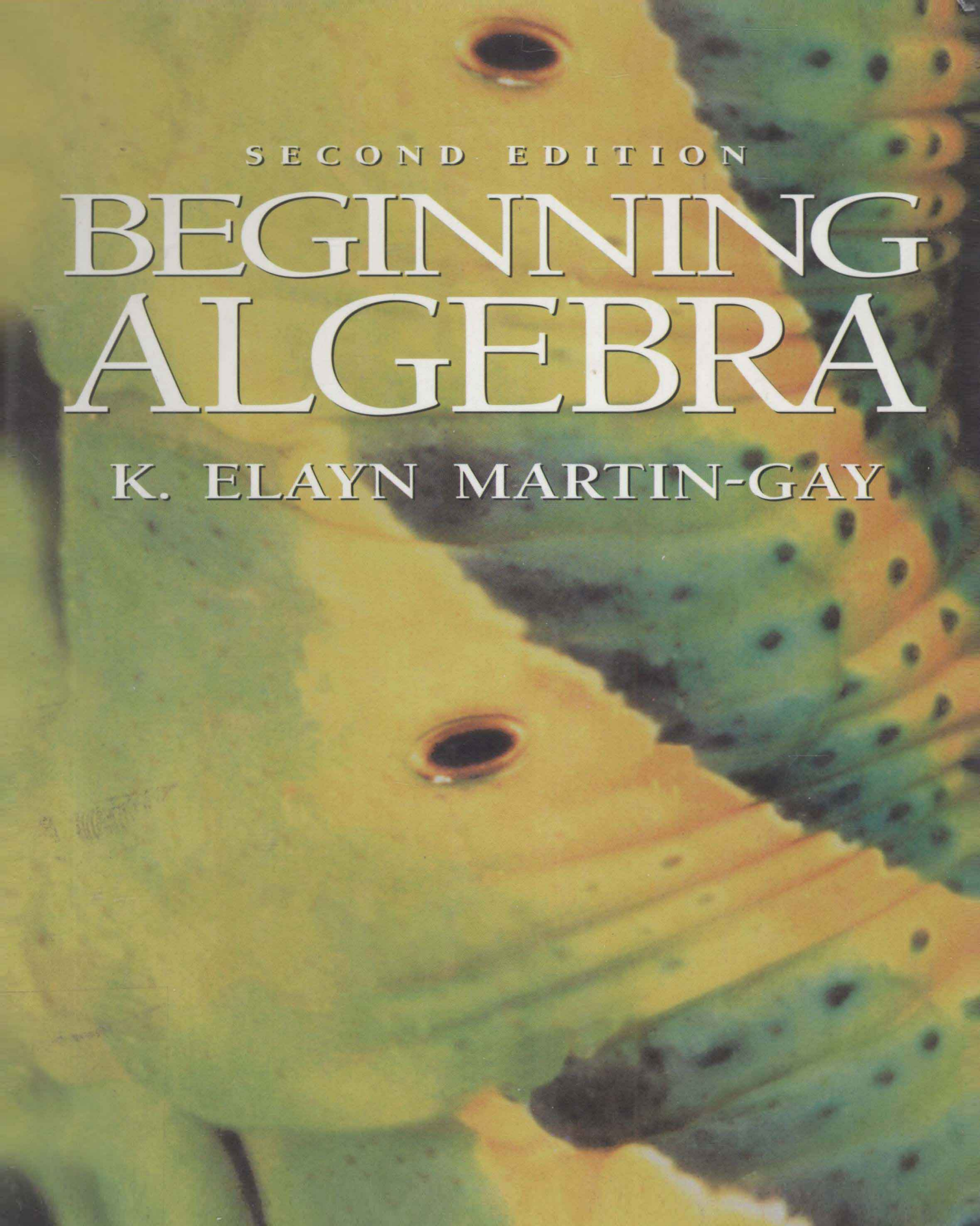
SECOND EDITION
BEGINNING ALGEBRA
K. ELAYN MARTIN-GAY

# BEGINNING ALGEBRA

SECOND EDITION

**K. ELAYN MARTIN-GAY**
University of New Orleans

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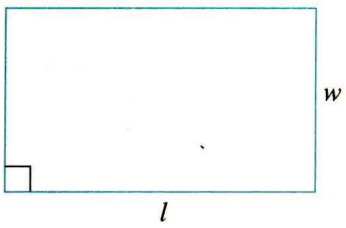
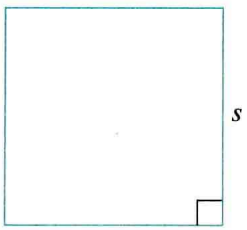
# GEOMETRIC FORMULAS

## RECTANGLE



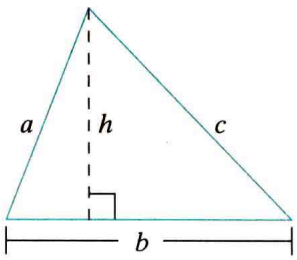

Perimeter: $P = 2l + 2w$
Area: $A = lw$

## SQUARE



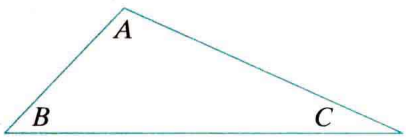

Perimeter: $P = 4s$
Area: $A = s^2$

## TRIANGLE



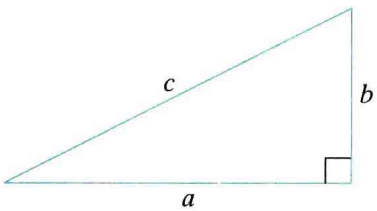

Perimeter $P = a + b + c$
Area: $A = \frac{1}{2}bh$

## SUM OF ANGLES OF TRIANGLE



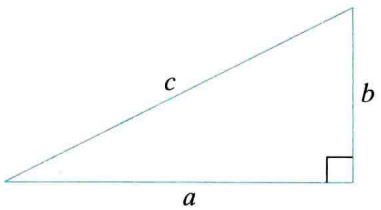

$A + B + C = 180°$
The sum of the measures of the three angles is 180°.

## RIGHT TRIANGLE



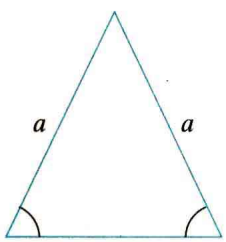

Perimeter: $P = a + b + c$
Area: $A = \frac{1}{2}ab$
One 90° (right) angle

## PYTHAGOREAN THEOREM (FOR RIGHT TRIANGLES)



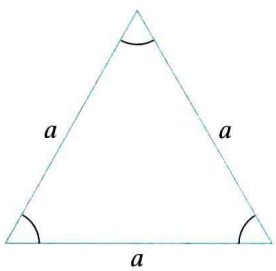

$a^2 + b^2 = c^2$

## ISOSCELES TRIANGLE



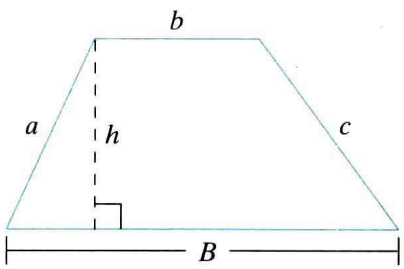

Triangle has:
two equal sides and
two equal angles.

## EQUILATERAL TRIANGLE



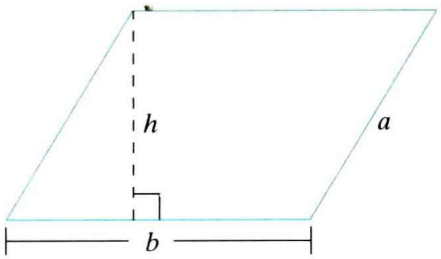

Triangle has:
three equal sides and
three equal angles.
Measure of each angle is 60°.

## TRAPEZOID



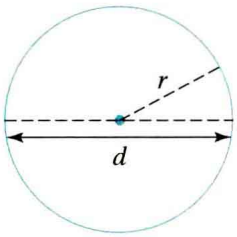

Perimeter: $P = a + b + c + B$
Area: $A = \frac{1}{2}h(B + b)$

### Parallelogram



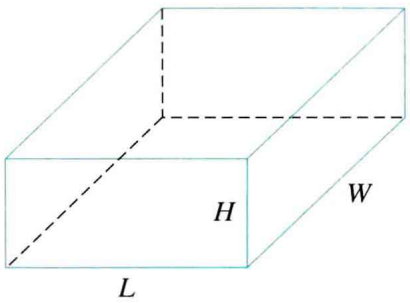

Perimeter: $P = 2a + 2b$
Area: $A = bh$

### Circle



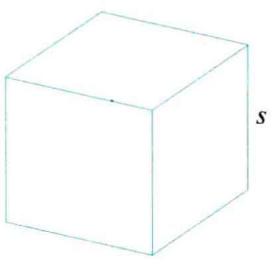

Circumference: $C = \pi d$
$C = 2\pi r$
Area: $A = \pi r^2$

### Rectangular Solid



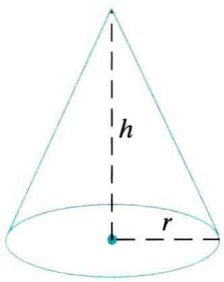

Volume: $V = LWH$
Surface Area: $A = 2HW + 2LW + 2LH$

### Cube



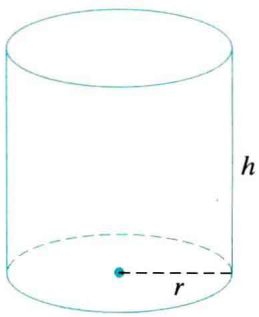

Volume: $V = s^3$
Surface Area: $A = 6s^2$

### Cone




Volume: $V = \frac{1}{3}\pi r^2 h$
Surface Area: $A = \pi r\sqrt{r^2 + h^2}$

### Right Circular Cylinder




Volume: $V = \pi r^2 h$
Surface Area:
$A = 2\pi rh + 2\pi r^2$

### Other Formulas

Distance: $d = rt$ ($r$ = rate, $t$ = time)

Temperature: $F = \frac{9}{5}C + 32 \qquad C = \frac{5}{9}(F - 32)$

Simple Interest: $I = Prt$
($P$ = principal, $r$ = annual interest rate, $t$ = time in years)

Compound Interest: $A = P\left(1 + \frac{r}{n}\right)^{nt}$
($P$ = principal, $r$ = annual interest rate, $t$ = time in years, $n$ = number of compoundings per year)

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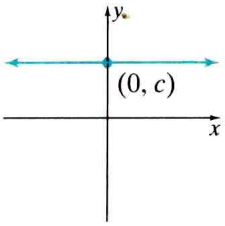
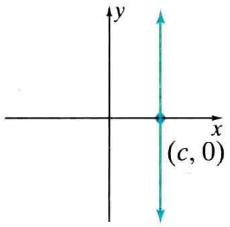
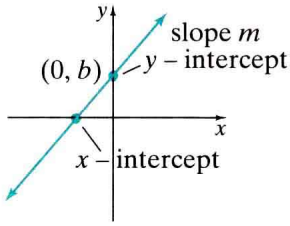
# COMMON GRAPHS



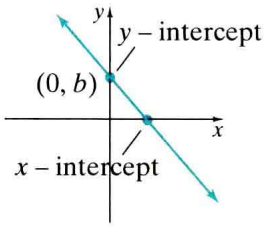

Horizontal Line;
Zero Slope
$y = c$



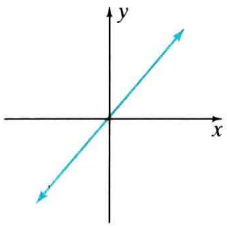

Vertical Line;
Undefined Slope
$x = c$



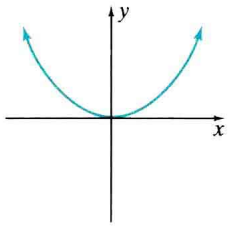

Linear Equation;
Positive Slope
$y = mx + b; m > 0$



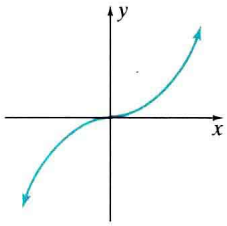

Linear Equation;
Negative Slope
$y = mx + b; m < 0$



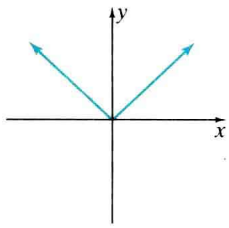

$y = x$



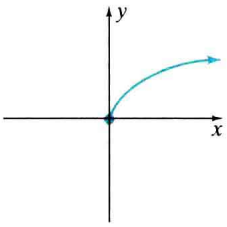

$y = x^2$



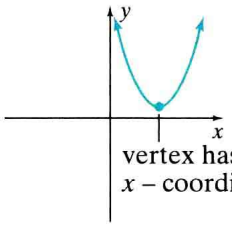

$y = x^3$



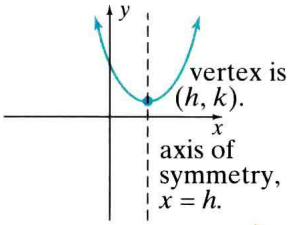

$y = |x|$




$y = \sqrt{x}; x \geq 0$

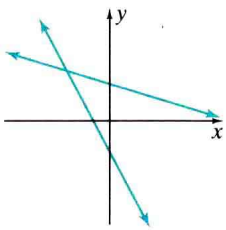



Quadratic Equation
$y = ax^2 + bx + c; a \neq 0$
Parabola opens upward if $a > 0$
Parabola opens downward if $a < 0$

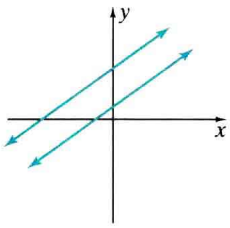



Quadratic Equation
$y = a(x - h)^2 + k; a \neq 0$
Parabola opens upward if $a > 0$
Parabola opens downward if $a < 0$

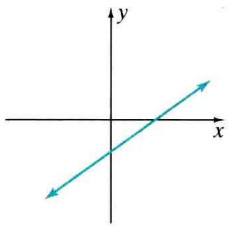
## SYSTEMS OF LINEAR EQUATIONS




Independent and
consistent; one solution




Independent and
inconsistent; no solution




Dependent and
consistent; infinitely many solutions

# Algebraic Formulas

**Slope of a Line Containing Points $(x_1, y_1)$ and $(x_2, y_2)$**

$$m = \frac{y_2 - y_1}{x_2 - x_1}, \text{ if } x_1 \neq x_2$$

The slope is $m$.

**Slope-Intercept Form of the Equation of a Line**

$$y = mx + b$$

The slope is $m$ and $y$-intercept is $b$.

**Point-Slope Form of the Equation of a Line**

$$y - y_1 = m(x - x_1)$$

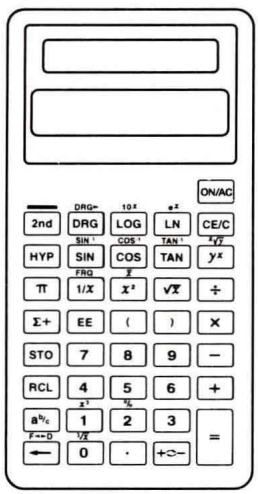
The slope is $m$ and point $(x_1, y_1)$ is on the line.

**Quadratic Formula**

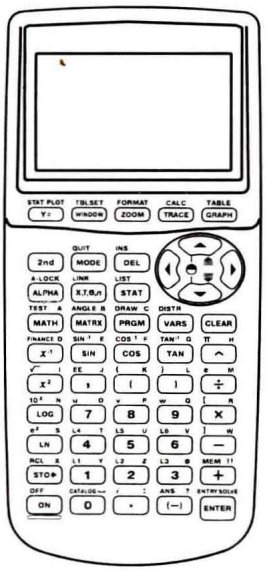
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Yields solutions of an equation of the form $ax^2 + bx + c = 0$, where $a \neq 0$.

# Reference to Selected Keys on Scientific and Graphing Calculators



Scientific Calculator



Graphing Calculator (Optional)

| | |
|---|---|
| [=] or [ENTER] | Gives the result of the current operation. |
| [$y^x$] or [$a^b$] or [^] | Raises any base to a power. For example, $4^5$ as 1024. |
| [EXP] or [EE] | Use to enter a number in scientific notation. For example, $6.1 \times 10^8$. |
| [+/−] or [(−)] | Changes the sign of the displayed number. Also, use to enter a negative value. (This is not the subtraction key.) |
| [1/x] or [$x^{-1}$] | Finds the reciprocal of a displayed number. |
| [STO] or [STO→] | Stores a number in memory. |
| [RCL] or [RCL STO→] | Recalls a number stored in memory. May need to press 2nd STO |
| [$x^2$] | Squares the displayed number. |
| [DEL] | On a graphing calculator, deletes previously entered characters. |
| [X, T] or [X, T, θ] or [X, T, θ, n] | On a graphing calculator, use to write the variable $x$. |
| [y =] | On a graphing calculator, use to enter equation(s) to be graphed. |
| [WINDOW] or [RANGE] | On a graphing calculator, use to set the viewing window to choose the part of the coordinate plane to be displayed. |
| [ZOOM] | On a graphing calculator, use to "zoom-in" or "zoom-out" to magnify or reduce a part of the curve. Can also be used to obtain a "square" setting, providing equal spacing between tic marks on the $x$- and $y$-axes to obtain a true geometric perspective. |
| [TRACE] | On a graphing calculator, use to find the $x$- and $y$-coordinates of points on a curve. |
| [GRAPH] | On a graphing calculator, use to graph a previously entered equation(s). |
| TABLE [GRAPH] or [2nd] [GRAPH] | On a graphing calculator, use for a table of values relating to an entered equation. The table can be used to estimate an answer to a problem. |
| [OFF] or [2nd] [OFF] | Turns calculator off. |

To my mother, Barbara M. Miller,
and her husband, Leo Miller,
and to the memory
of my father, Robert J. Martin

# PREFACE

## ABOUT THIS BOOK

This book was written to provide a solid foundation in algebra for students who might have had no previous experience in algebra. Specific care has been taken to prepare students to go on to their next course in mathematics, and to help students to succeed in nonmathematical courses that require a grasp of algebraic fundamentals. I have tried to achieve this by writing a user-friendly text that is keyed to objectives and contains many worked-out examples. The basic concepts of graphing are introduced early, and applications, data interpretation, and geometric concepts are emphasized and integrated throughout the book.

The many factors that contributed to the success of the first edition have been retained. In preparing this edition, I considered the comments and suggestions of colleagues throughout the country and of the many users of the first edition. The AMATYC Crossroads Document and the NCTM Standards (plus Addenda), together with advances in technology, also influenced the careful reexamination of every section of the text. All of these inputs helped to update the presentation, enhancing the content and pedagogical value.

## KEY PEDAGOGICAL FEATURES IN THE SECOND EDITION

**Readability and Connections** Many reviewers of this edition as well as users of the previous edition have commented favorably on the readability and clear, organized presentation. I have tried to make the writing style as clear as possible while still retaining the mathematical integrity of the content. When a new topic is presented, an effort has been made to relate the new ideas to those the students may already know. Constant reinforcement and connections within problem-solving strategies, data interpretation, geometry, patterns, graphs, and situations from everyday life can help students gradually master both new and old information.

**Problem-Solving Process** This is formally introduced in Chapter 2, with a new six-step process that is integrated throughout the text. The six steps are *Understand,*

*Assign, Illustrate, Translate, Complete,* and *Interpret.* The repeated use of these steps in a variety of examples shows their wide applicability. Reinforcing the steps can increase students' comfort level and confidence in tackling problems.

**Applications and Connections** This book contains a wealth of practical applications found throughout the book in worked-out examples and exercise sets. The applications help to motivate students and strengthen their understanding of mathematics in the real world. They help show connections to a wide range of areas such as biology, environmental issues, consumer applications, allied health, business, entertainment, history, art, literature, finance, sports, and music, as well as to related mathematical areas such as geometry. Many involve interesting real-life data. Sources for data include newspapers, magazines, government publications, and reference books. Opportunities for obtaining your own real data are also included.

**Group Activities** Each chapter opens with a photograph and description of a real-life situation. At the close of the chapter, students can work cooperatively to apply the algebraic and critical thinking skills they have learned to make decisions and answer the Group Activity that is related to the chapter opening situation. The Group Activity is a multi-part, often hands-on, problem. These new situations, designed for student involvement and interaction, allow for a variety of teaching and learning styles. Answers and tips for instuctional strategies for Group Activities are available in the Annotated Instructor's Edition. In addition, there are opportunities for group activities within section exercise sets.

**Reminder** Reminders, formerly Helpful Hint boxes, contain practical advice on problem solving. Reminders appear in the context of material in the chapter and give students extra help in understanding and working problems. They are highlighted in a box for quick reference.

**Exercise Sets** Each exercise set is divided into two parts. Both parts contain graded problems. The first part is carefully keyed to worked examples in the text. Once a student has gained confidence in a skill, the second part contains exercises not keyed to examples. There are ample exercises throughout the book, including end-of-chapter reviews, tests, and cumulative reviews. In addition, each exercise set contains one or more of the following features.

***Mental Mathematics*** These problems are found at the beginning of an exercise set. They are mental warmups that reinforce concepts found in the accompanying section and increase students' confidence before they tackle an exercise set. By relying on their own mental skills, students increase not only their confidence in themselves, but also their number sense and estimation ability.

***Conceptual and Writing Exercises*** These exercises, now found in almost every exercise set, are keyed with the icon . These exercises require students to show an understanding of a concept learned in the corresponding section. This is accomplished by asking students questions that require them to use two or more concepts together. Some require students to stop, think, and explain in their own words the

concept(s) used in the exercises they have just completed. Guidelines recommended by the American Mathematical Association of Two Year Colleges (AMATYC) and other professional groups recommend incorporating writing in mathematics courses to reinforce concepts.

***Data and Graphical Interpretation*** There is increased emphasis on data interpretation in exercises via tables and graphs. The ability to interpret data and read and create a variety of types of graphs is developed gradually so students become comfortable with it. In addition, a new appendix on mean, median, and mode together with exercises is included.

***Scientific Calculator Explorations and Exercises*** Scientific Calculator Explorations, although optional, contain examples and exercises to reinforce concepts or motivate discovery learning. This feature is placed appropriately throughout the text to instruct students on the proper use of the calculator.

Additional exercises building on the skills developed in the Explorations may be found in exercise sets throughout the text, and are marked with an icon .

***Graphing Calculator Explorations and Exercises*** For graphing calculators or computer graphing utilities, these new Explorations are integrated appropriately throughout the text. Entirely optional, they contain examples and exercises to reinforce concepts, help interpret graphs, or motivate discovery learning.

Additional new exercises building on the skills developed in the Explorations may be found in exercise sets throughout the text, and are marked with an icon .

***Review Exercises*** Formerly called Skill Review, these exercises are found at the end of each section after Chapter 1. These problems are keyed to earlier sections and review concepts learned earlier in the text that are needed in the next section or in the next chapter. These exercises show the connections between earlier topics and later material.

***A Look Ahead*** These are examples and problems similar to those found in a next algebra course. "A Look Ahead" is presented as a natural extension of the material and contains an example followed by advanced exercises. I strongly suggest that any student who plans to take another algebra course work these problems.

**Graphics** The text contains numerous graphics, models, and illustrations to visually clarify and reinforce concepts. These include new bar charts, line graphs, calculator screens, application illustrations, and geometric figures. The inside front cover of the text includes a quick reference to geometric figures and formulas, and the inside back cover now includes a summary of common graphs.

**Chapter Highlights** Found at the end of each chapter, the new Chapter Highlights contain key definitions, concepts, and examples to help students understand and retain what they have learned.

**Chapter Review and Test** The end of each chapter contains a review of topics introduced in the chapter. These review problems are keyed to sections. The chapter test is not keyed to sections.

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**Cumulative Review** Each chapter after the first contains a cumulative review. Each problem contained in the cumulative review is actually an earlier worked example in the text that is referenced in the back of the book along with the answer. Students who need to see a complete worked-out solution, with explanation, can do so by turning to the appropriate example in the text.

**Functional Use of Color and Design** Elements of the text are highlighted with color or design to make it easier for students to read and study.

**Videotape and Software Icons** At the beginning of each section, videotape and software icons are displayed. These icons help reinforce that these learning aids are available should students wish to use them to help them review concepts and skills at their own pace. These items have direct correlation to the text and emphasize the text's methods of solution.

## KEY CONTENT FEATURES IN THE SECOND EDITION

**Overview** In addition to the traditional topics in beginning algebra courses, this text contains a strong emphasis on problem solving, and geometric concepts and reading and interpreting graphs and data are integrated throughout. The geometry concepts covered are those most important to a student's understanding of algebra, and I have included many applications and exercises devoted to this topic. Also, geometric figures and a review of angles, lines, and special triangles are covered in the appendices. I have also integrated reading and interpreting line and bar graphs throughout the text. Not only does this naturally lead to the rectangular coordinate system and beyond, but it gives students practice at interpreting real data. Students are also given the opportunity to see how today's technology can be of help. Exercises are a critical part of student learning, and particular care was taken in writing these.

**Increased Emphasis on Data Interpretation** There is an increased emphasis on data interpretation via tables and graphs that begins in the first section of the book and continues throughout the text. The ability to interpret data and a variety of types of graphs including bar, line, and circle graphs is developed gradually so students become comfortable with it. In addition, a new appendix on mean, median, and mode is included.

**Early and Intuitive Introduction to Graphing** As bar and line graphs are gradually introduced in Chapters 1 and 2, an emphasis is slowly placed on the notion of paired data. This leads naturally to the concepts of ordered pair and the rectangular coordinate system introduced in Chapter 3. Chapter 3 is devoted to graphing and concepts of graphing linear equations such as slope and intercepts. These concepts are reinforced throughout exercise sets in subsequent chapters, helping prepare students for more work with equations of lines in Chapter 7.

**Increased Emphasis on Problem Solving** Building on the strengths of the first edition, a special emphasis and strong commitment is given to contemporary and practical applications of algebra. Real data was drawn from a variety of sources including magazines, newspapers, government publications, and reference books. Generating and using personal real data is also encouraged.

**Increased Opportunities to Use Technology** Optional calculator as well as graphing calculator explorations are integrated appropriately throughout the text.

**New Examples** Additional detailed step-by-step examples were added where needed. Many of these reflect real life. Examples are used in two ways. Often there are numbered, formal examples, and occasionally an example or application is used to introduce a topic or informally discuss the topic.

**New Exercises** A significant amount of time was spent on the exercise sets. New exercises and additional examples help address a wide range of student learning styles and abilities. New kinds of exercises include group activities, conceptual and writing exercises, multi-part exercises, optional graphing calculator exercises, and data analysis from tables and graphs. In addition, the mental math, drill, and word problems were refined and enhanced.

## SUPPLEMENTS FOR THE INSTRUCTOR

### PRINTED SUPPLEMENTS

**Annotated Instructor's Edition** (ISBN 0-13-568460-9)

- Answers to exercises on the same text page or in Instructor's Answers section
- Instructor's Answers section contains answers to exercises requiring graphical solutions
- Instructor's Answers section also contains answers and pedagogical suggestions for group activities
- Notes to the Instructor

**Instructor's Solutions Manual** (ISBN 0-13-568379-3)

- Solutions to even-numbered exercises, chapter tests, and cumulative review exercises
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  —three forms contain multiple-choice items
  —three forms contain free-response items

- Two forms of Cumulative Review Tests
  —every two chapters
- Final Exams
  —four forms with free-response scrambled items
  —four forms with multiple-choice scrambled items
- Answers to all items

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- Comprehensive text-specific testing
- Generates test questions and drill worksheets from algorithms keyed to the text learning objectives
- Edit or add your own questions
- Compatible with Scantron or possible other scanners

### USING INTERNET AND WEB BROWSER

Using the Internet and a Web browser, such as Netscape, can add to your mathematical resources. Below is a list of some of the sites that may be worth your or your students' visit.

- Prentice Hall Home Page http://www/prenhall.com
- The Mathematical Association of America http://www/maa.org
- The American Mathematical Society http://www/ams.org
- The National Council of Teachers of Mathematics http://www/nctm.org
- The Census Bureau http://www.census.gov
- Texas Instruments http://www.ti.com/calc
- The Math Archives http://archives.math.utk.edu

### INTERNET GUIDE

- Contact your local Prentice Hall representative.

## SUPPLEMENTS FOR THE STUDENT

### PRINTED SUPPLEMENTS

**Student Solutions Manual** (ISBN 0-13-568387-4)

- Detailed step-by-step solutions to odd-numbered text and review exercises
- Solutions to all chapter practice tests and cumulative review exercises
- Solution methods reflect those emphasized in the text
- Ask your bookstore about ordering

**Student Study Guide** (ISBN 0-13-568403-X)

- Additional step-by-step worked out examples and exercises
- Practice tests and final examination
- Solution methods reflect those emphasized in the text
- Includes study skills and note-taking suggestions
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**New York Times Supplement**

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K. Elayn Martin-Gay

## ABOUT THE AUTHOR

K. Elayn Martin-Gay has taught mathematics at the University of New Orleans for over 16 years and has received numerous teaching awards, including the local University Alumni Association's Award for Excellence in Teaching.

Over the years, Elayn has developed a videotaped lecture series to help her students understand algebra better. This highly successful video material is the basis for the four-book series, *Prealgebra, Beginning Algebra, Intermediate Algebra,* and *Introductory and Intermediate Algebra,* a combined approach.

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